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EXAMINER	
KIELIN, ERIK J	

ART UNIT	PAPER NUMBER
2813	39

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 08/636,069	Applicant(s) SANDHU ET AL.
	Examiner Erik Kielin	Art Unit 2813

-- Th MAILING DATE of this communication appears on th cov r sh t with th corr spondenc addr ss --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *11 March 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,2,4-6,31,33-36 and 38-54* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,2,4-6,31,33-36 and 38-54* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *22 April 1996* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Examiner's Amendment

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Daniel Kluth on 17 March 2003.

The application has been amended as follows:

Claim 32 was canceled to avoid the presence of duplicate claims. Claim 32 was an equivalent to claim 51.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claims 1, 2, 4-6, 31, 33-36, and 38-54 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Each independent claim, 1, 31, 42, 43, 45-48, and 50-53, recites the limitation that the reaction volume of gases located above the substrate within a chemically reactive distance of the

substrate is exposed to a light source "without directly exposing the substrate to the light source." The specification, however, states, that it is not necessary "to illuminate the substrate surface" (p. 7, lines 21-26). As presently written, the amendments to each independent claim, still includes indirectly exposing the substrate such as by reflection off of a mirror or a diffraction grating which is *not* supported by the specification. The specification, on the other hand, only supports not illuminating the substrate surface, which *excludes* indirect exposure of the substrate to the light source. Accordingly, the claims as presently written are not supported by the specification because the amended claim language is not in the specification and furthermore has no basis from the specification for any indirect, or not directly, exposing the substrate to the light source.

4. Claims 45 and 50 are rejected under 35 U.S.C. 112, first paragraph, as based on a disclosure which is not enabling. Ozone or some oxygen source, critical or essential to the practice of the invention, but not included in the claim(s) is not enabled by the disclosure. See *In re Mayhew*, 527 F.2d 1229, 188 USPQ 356 (CCPA 1976). Each of claims 45 and 50 deposit a silicon oxide layer, and require illumination to increase the functional atomic oxygen concentration, yet no oxygen source has been provided in the claim. The specification indicates that this source is ozone. This feature is critical because the functional atomic oxygen concentration cannot be increased if there is no oxygen source present. Moreover, silicon dioxide --an oxygen-containing material-- cannot be deposited in the absence of an oxygen source.

5. Claims 1, 2, 4-6, 31, 33-36, and 38-54 are rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for a pressure on the order of 0.01 atmosphere

(7.6 Torr), does not reasonably provide enablement for a pressure range of 200 to 760 Torr. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to use the invention commensurate in scope with these claims.

Each independent claim, 1, 31, 42, 43, 45-48, and 50-53, recites the limitation that the pressure range is between 200 Torr and 760 Torr. However, the claims require that only the reaction volume is illuminated without illuminating the substrate and that heterogeneous reactions must take place in the reaction volume as opposed to homogeneous reactions. As will be explained below, the specification has not enabled how one of ordinary skill could illuminate only the reaction volume in the pressure range of 200 Torr to 760 Torr while also maintaining only heterogeneous reactions.

US 4,579,750 (Bowen et al.) teaches that in order to reduce the probability of homogeneous reactions and enhance the probability of heterogeneous reactions, the illuminated region must be focus above the substrate and must be absorbed by the reactive gas molecules "within a few mean free path lengths of the gaseous molecules" of the substrate surface. (See Bowen, col. 3, lines 19-43 -- especially lines 32-35.) According to the teaching in Bowen, then, in order only to reduce the probability of homogenous reactions from occurring in the reaction volume, the illuminated region (i.e. the reaction volume) must be only a few mean free path lengths thick.

The mean free path of a gas molecule is defined as the distance between collisions with other gas molecules or a surface and is given by the equation

$$\lambda = 5 \cdot 10^{-3}/P$$

where λ is the mean free path in cm (centimeters) and P is the pressure in Torr. (Ohring, The Material Science of Thin Films, Academic Press: Boston, 1992, p. 53.) Given Applicant's presently claimed pressure range of 200 Torr to 760 Torr in each independent claim, the mean free path length is from 0.065 μm to 0.24 μm (65 nm to 240 nm); therefore, the thickness of the illuminated region must be at most about 0.72 μm (720 nm) or 3 times 0.24 μm in order to reduce the probability of homogeneous reactions.

Applicant indicates that an array of lamps, or specifically mercury arc vapor lamps (specification, p. 7, lines 21-29), are used to provide the illumination. Mercury arc vapor lamps emit, *inter alia*, UV wavelengths of 253 nm, 296 nm, and 365 nm (US 3,866,083 Datta et al.; col. 1, lines 10-16)--which is on the order of the thickness of the reaction volume required to reduce the probability of homogeneous reactions. Accordingly, the light form the mercury arc vapor lamp must be reshaped somehow into a beam thickness on the order of the wavelength of the light being emitted. However, any attempt to reduce the thickness of the incoherent light emitted from lamp down to the order of the wavelength of light emitted (by a slit or focusing lens on the order of the wavelength) will necessarily result in diffraction or "spreading out" of the light beam. (See Harrison, The Cassell Dictionary of Physics, Cassell: London, 1988, pp. 44-45--especially the section entitled "diffraction.") This then would necessarily result in the light source illuminating the substrate -- contrary to the requirement in the claims.

By contrast, Bowen teaches that a lower pressure, on the order of 7.6 Torr (λ = 6.5 μm or 6500 nm, several times thicker than that λ at 200 Torr to 760 Torr), is necessary to reduce the probability of homogeneous reactions (Bowen, col. 9, lines 22-36), and also uses a laser --a

coherent light source-- to attain illumination of only the thin reaction volume above the surface of the substrate.

According to the evidence of record, illumination of only the reaction volume without also illuminating the substrate surface at a pressure or 200 Torr to 760 Torr using while maintaining only heterogeneous reactions cannot happen. For this reason, the claims are not enabled. Note that the specification states that 1.0 Torr to 760 Torr are pressures that can be used (p. 7, lines 3 and 4). A coherent light source such as a laser and a pressure of less than about 7.6 Torr, as taught by Bowen, would work. The specification does not provide for use of a coherent light source.

The remaining claims are rejected for depending from the independent claims.

Drawings

6. The disclosure is objected to under 37 CFR 1.81(a) and 37 CFR 1.83(a), as failing to . have drawings necessary to understand the invention. Drawings are necessary to understand the following: The apparatus by which the silicon dioxide is formed --especially wherein illumination of only the reaction volume, but not the substrate, while maintaining only heterogeneous reactions and not homogeneous reactions, in a pressure in the range of 200 Torr to 760 Torr. Any structural detail that is essential for a proper understanding of the disclosed invention should be shown in the drawing. MPEP § 608.02(d). A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. Claims **31**, 33, 34, 38-40, **42**, **51**, and **52**, are rejected under 35 U.S.C. 103(a) as being unpatentable over US 4,581,248 (**Roche**) in view of JP 02-050966 (**Hisamune**), and considered with US 4,579,750 (**Bowen** et al.) for a showing of inherency.

Regarding independent claims 31, 42, 51, and 52, **Roche** discloses a method of depositing a silicon dioxide layer on a substrate surface comprising,

heating a substrate **22** to a temperature of about 20 °C to 600 °C, with specific examples at 450 °C and 500 °C (col. 7, lines 1-3 and Table I) which overlaps 480 °C to 700 °C;

contacting the substrate **22** with a reaction volume **25** of gas located above the substrate surface within a chemically reactive distance of the substrate (col. 2, lines 17-32; col. 3, lines 35-45; col. 7, lines 64-65), the reaction volume of gas comprising an SiO_2 precursor and an oxygen source -- namely N_2O in a carrier gas of nitrogen --as further limited by instant claims 33 and 34, (col. 3, lines 53-62; col. 4, line 66 to col. 5, line 38);

illuminating the reaction volume of gas **25** from a high intensity light source -- specifically an ArF laser (col. 5, line 2), without illuminating the substrate (col. 2, lines 17-32) to increase the functional oxygen concentration (col. 5, lines 34-39); and

subjecting the reaction volume of gas to about 8 Torr during the deposition (col. 5, lines 43-48).

The limitation that the fixed charge in the deposited film is reduced is also inherently met because Applicant's specification specifically states that it is the atomic oxygen reduces fixed charge. (See instant specification, paragraph bridging pages 7 and 8.)

The limitation that the reactant gases in the reaction volume undergo heterogeneous reactions rather than homogeneous reactions is met because **Roche** indicates that reactant species are only formed where the laser light is provided (i.e. the region **25**; Roche, col. 7, lines 64-65) and because **Bowen** --who teaches the same photo CVD method as **Roche**-- indicates that irradiating the only region just above the substrate and keeping the pressure around 0.01 atm (7.6 Torr) will reduce the probability of homogeneous reactions in the reaction volume and promote heterogeneous reactions (i.e. reactions between the reactant gases and the substrate surface). (See Bowen, col. 3, lines 20-43.)

Further in this regard, the limitation "the reactant gases in the reaction volume taking part in heterogeneous chemical reactions, rather than homogeneous reactions taking place in the gas volume in the chamber outside the reaction volume" is also necessarily met because Applicant has defined the reaction volume by the existence of the presence of heterogeneous reactions and the absence of homogeneous reactions. The specification merely *defines* such homogeneous reactions as those which occur outside "the reaction volume," but does not limit homogeneous reactions from taking place. (See instant specification, p. 7 --especially lines 15-20.)

Roche does not teach a pressure in the range of 200 Torr to 760 Torr or more specifically about 200 Torr --as further limited by instant claim 38. If it is thought that these pressures are somehow enabled, then this may be a difference. However, it has been held that "claimed ranges of a result effective variable, which do not overlap the prior art ranges, are unpatentable unless

they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art." See *In re Huang*, 40 USPQ2d 1685, 1688(Fed. Cir. 1996). In this case, Applicant's specification, as noted above, teaches that the pressure range in which the instant invention works is 1.0 Torr to 760 Torr. Accordingly, the specification does not provide evidence of a new and unexpected result for the pressure of 200 Torr or the range of from 200 Torr to 760 Torr, as per the required precedent.

Further regarding the independent claims 31, 42, 51, 52, and claim 39, **Roche** does not teach using ozone as the oxygen source or TEOS as the SiO_2 precursor.

Hisamune teaches a photo-assisted CVD method wherein the TEOS and ozone are used to deposit a SiO_2 film and wherein UV light is used in conjunction with the oxygen source to increase the functional oxygen concentration. (See Hisamune translation pp. 4-7.)

It would have been obvious for one of ordinary skill in the art, at the time of the invention to use ozone and TEOS as the precursors in **Roche**, as taught by **Hisamune**, because one of ordinary skill would recognize that ozone and TEOS work just as well for forming a silicon dioxide film by photo CVD, as taught by **Hisamune**. In this regard, it has been held that the selection of a known material based on its suitability for its intended use is *prima facie* obvious. The selection of a known material based on its suitability for its intended use supported a *prima facie* obviousness determination in *Sinclair & Carroll Co., Inc. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 1945) (Claims to a printing ink comprising a solvent having the vapor pressure characteristics of butyl carbitol so that the ink would not dry at room temperature but would dry quickly upon heating were held invalid over a reference teaching a printing ink made with a different solvent that was nonvolatile at room temperature but highly volatile when heated

in view of an article which taught the desired boiling point and vapor pressure characteristics of a solvent for printing inks and a catalog teaching the boiling point and vapor pressure characteristics of butyl carbitol. "Reading a list and selecting a known compound to meet known requirements is no more ingenious than selecting the last piece to put in the last opening in a jig - saw puzzle." 65 USPQ at 301.). See also *In re LESHIN*, 125 USPQ 416 (CCPA 1960) ("Mere selection of known plastics to make container-dispenser of a type made of plastics prior to the invention, the selection of the plastics being on the basis of suitability for the intended use, would be entirely obvious; and in view of 35 U.S.C. 103 it is a wonder that the point is even mentioned.") (See MPEP 2144.07.)

Then regarding claims 40 and further regarding independent claims 42 and 52, while **Roche** does not teach a dopant, **Hisamune** teaches the use of trimethylphosphite as the dopant source to form phosphorus-doped SiO_2. (See Hisamune p. 2, p. 6, and p. 7, the sentence before Table 1.)

It would have been obvious for one of ordinary skill in the art, at the time of the invention to add phosphorous dopant, as taught by **Hisamune**, to the SiO_2 film of **Roche**, in order to form a phosphorous-doped silicate glass which is desired in the semiconductor fabrication art, as taught by **Hisamune**, which is known to getter contaminant ions such as sodium and moisture and also to reduce the reflow temperature of the glass.

Then further regarding independent claims 51 and 52, **Roche** does not teach the use of a mercury arc vapor lamp. If it is believed that use of this light source is enabled for the pressure range of 200 Torr to 760 Torr, then this may be a difference. **Hisamune** teaches the use of a mercury vapor lamp to illuminate the reaction gas mixture.

It would have been obvious for one of ordinary skill in the art, at the time of the invention to use a mercury vapor lamp, as the light source of **Roche**, as long as it could illuminate the region just above the substrate, because each of **Roche** and **Hisamune** use an ultraviolet light source to provide an increase in atomic oxygen (Roche, col. 5, lines 2-20 and 34-39; Hisamune, Table 1), such that a mercury arc vapor lamp would be expected to work just as the Roche UV laser, since both produce the required UV light.

9. Claim 35 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Roche** in view of **Hisamune** and considered with **Bowen**, as applied to claim 31 above, and further in view of US 5,112,647 (**Takabayashi**).

Regarding claim 35, the prior art of **Roche** in view of **Hisamune**, as explained above, discloses each of the claimed features except for specifying that helium may be the carrier gas..

Takabayashi teaches a photo CVD method wherein the light is provided just over the surface of the substrate without directly illuminating the substrate and uses He as the carrier gas (col. 5, lines 51-67).

It would have been obvious for one of ordinary skill in the art, at the time of the invention to use helium as the carrier gas of **Roche** in view of **Hisamune** because **Roche** uses a carrier gas, and **Takabayashi** teaches the helium is a known carrier gas for photo CVD, such that one of ordinary skill would recognize that helium, being inert would work just as well as another inert gas. Moreover, it has been held that the selection of a known material based on its suitability for its intended use is *prima facie* obvious, as noted above.

10. Claim 36 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Roche** in view of **Hisamune** and considered with **Bowen**, as applied to claim 31 above, and further in view of US 5,605,867 (**Sato** et al.).

The prior art of **Roche** in view of **Hisamune**, as explained above, discloses each of the claimed features except for specifying the amount of ozone used in the deposition of the SiO_2 film.

Sato teaches a photo CVD method (paragraph bridging cols. 37-38) for depositing SiO_2 for semiconductor fabrication, using TEOS and O_3. **Sato** also teaches that the ozone can be varied over a wide range and teaches that 5% is an exemplary amount (col. 10, lines 13-21).

It would have been obvious for one of ordinary skill in the art, at the time of the invention to use 5% ozone in the reactant gas mixture, as taught by **Sato**, in the deposition method of **Roche** in view of **Hisamune**, because **Hisamune** is silent to the amount of ozone, such that one of ordinary skill would necessarily have to determine how much to add, and **Sato** teaches that Moreover, this claims is *prima facie* obvious without showing that the claimed ranges achieve unexpected results relative to the prior art range. *In re Woodruff*, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also *In re Huang*, 40 USPQ2d 1685, 1688(Fed. Cir. 1996)(claimed ranges of a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also *In re Boesch*, 205 USPQ 215 (CCPA) (discovery of optimum value of result effective variable in known process is ordinarily within skill of art) and *In re Aller*, 105 USPQ 233 (CCPA 1955) (selection of optimum ranges within prior art general conditions is obvious).

11. Claims **1**, 2, 4-6, 41, **43**, 44, **45**, **46**, **47**, **48**, 49, **50**, **53**, and 54 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Roche** in view of **Hisamune** and considered with **Bowen**, and further in view of EP 0 562 625 A2 (**Imai** et al.).

The prior art of **Roche** in view of **Hisamune** as explained above, discloses each of the claimed features, except for using at least two dopant sources (instant claims 43 and 53), specifically boron and phosphorous dopants as the two dopant sources (instant claims 1, 44, and 54), the specific dopant sources for boron (instant claims 4, 6, 41, 45), fluorine dopant in the SiO_2 (instant claims 46), fluorine and one dopant source (instant claim 47), fluorine and two additional dopant sources (instant claim 48), fluorine with boron and phosphorous as the two additional dopants (instant claim 49), the specific boron and fluorine sources (instant claim 50).

Imai teaches the benefits of forming a fluorine-doped BPSG (FBPSG) film to reduce the reflow temperature below that of BPSG alone. (See Abstract.) The FBPSG film is produced by a CVD method wherein ozone, TEB, TMOP, and FTES are used to form the FBPSG layer. (See section entitled "FIRST EMBODIMENT" beginning on p. 6.)

It would have been obvious for one of ordinary skill in the art, at the time of the invention to add boron, phosphorous, and fluorine, as taught by **Imai**, to the SiO_2 layer of **Roche**, or to add boron and fluorine to the phosphorous-doped SiO_2 of **Roche** in view of **Hisamune**, to reduce the reflow temperature of the SiO_2 layer, as taught to be beneficial in **Imai**.

Conclusion

12. This action is made non-final to give Applicant the opportunity to respond to the new grounds of rejection.

13. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

US 4,694,777 (**Roche**), US 4,782,787 (**Roche**), JP 62-77474 A (**Takamiya**), JP 5-186875 A (**Inoue** et al.), and JP 6-104181 A (**Watanabe**) each teach photo CVD of SiO_2, wherein the surface of the substrate is not illuminated and the reaction volume just over the substrates is illuminated. Additionally, **Takamiya** teaches the use of lamps.

Any inquiry concerning this communication from examiner should be directed to Erik Kielin whose telephone number is (703) 306-5980 and e-mail address is erik.kielin@uspto.gov. The examiner can normally be reached by telephone on Monday through Thursday 9:00 AM until 7:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached at (703) 308-4940 or by e-mail at carl.whitehead@uspto.gov. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-872-9319 for After Final communications.

Erik Kielin

March 19, 2003